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# Developing a Climate Science Education Professional Development Program

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PURDUE UNIVERSITY

NSF

# Outline

- Developing a climate education network (team) and program
- Climate education challenges


# Developing a Climate Science Professional Development Program

## Project Goals

- Goal 1. Develop a professional development program and tool kit for climate science
- Goal2. Implement professional development, using the tool kit (filed test and revise)
- Goal 3. Conduct a summer institute to prepare staff developers to use the professional development tool kit
- Goal 4. Establish the *Climate Science Education* network

# Team Members

- Adam Baker, Meteorologist, National Weather Service, Indianapolis
- Mary Cutler, Naturalist, Tippecanoe County Parks and Recreation Dept.
- Mark Koschmann, Science Teacher, St. John's Lutheran School, MI
- Ted Leuenberger, Science Teacher, Benton Jr./Sr. High School, retired
- Han Schmitz, Extension Educator, Purdue University
- Jan Sneddon, Director, Indiana Earth Force and President, Environmental Education Association of Indiana
- Olivia Kellner, Graduate Student

- Dev Niyogi (CoPI)

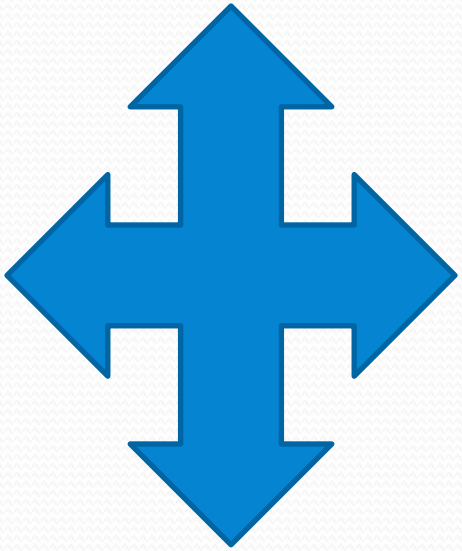
# Developing the Team (Program)

- Community Building
  a. Getting to know ourselves (Who are we?)
  b. Developing a common knowledge base (What do we need to know?)
  c. Developing a shared framework (What do we want people to know?)
- Strategic and Action Planning
  a. Developing a shared program (What do we want our program to look like?)
  b. Identifying resources and tools (What activities and resources do we need?)
- Practice and Revise
  a. What worked? What didn't work?
- Local Implementation
- Dissemination
- Assessment and Evaluation

# Program Themes

- Climate System, Weather and Climate
- Earth Energy Budget, GHE and Greenhouse Gases, Carbon Cycle
- Global Warming, Climate Change, and Climate Variability
- Changes to the Climate System
- Tools, Monitoring, Models, and Data Sets
- Personal and Community Action

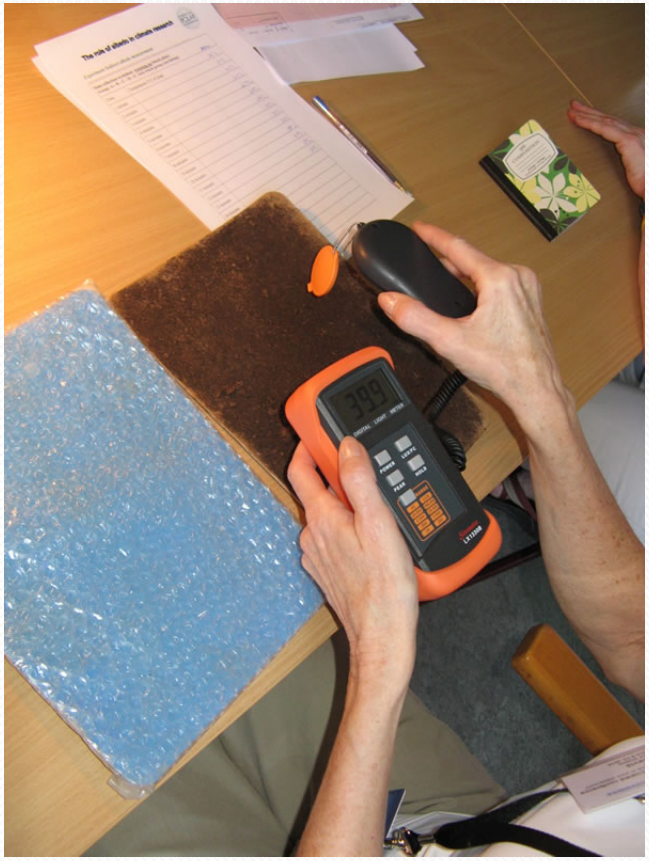
# Challenge: Time and Complexity

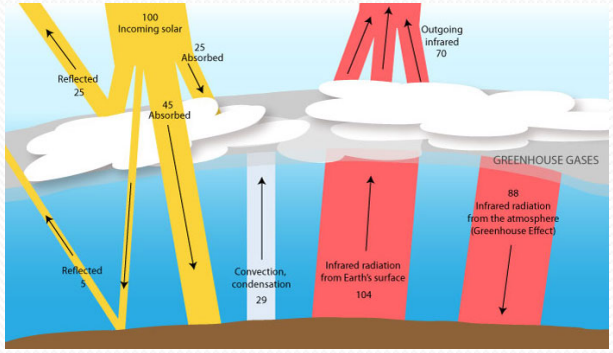


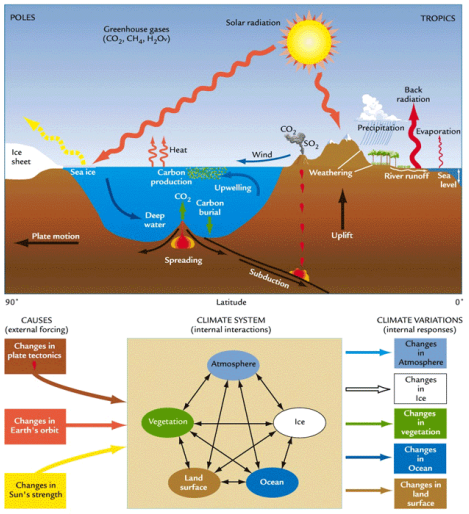
# Solution:

- Focus on Big Ideas/Key Concepts/Guiding Questions
- Link Abstract to Concrete
- Contextualize

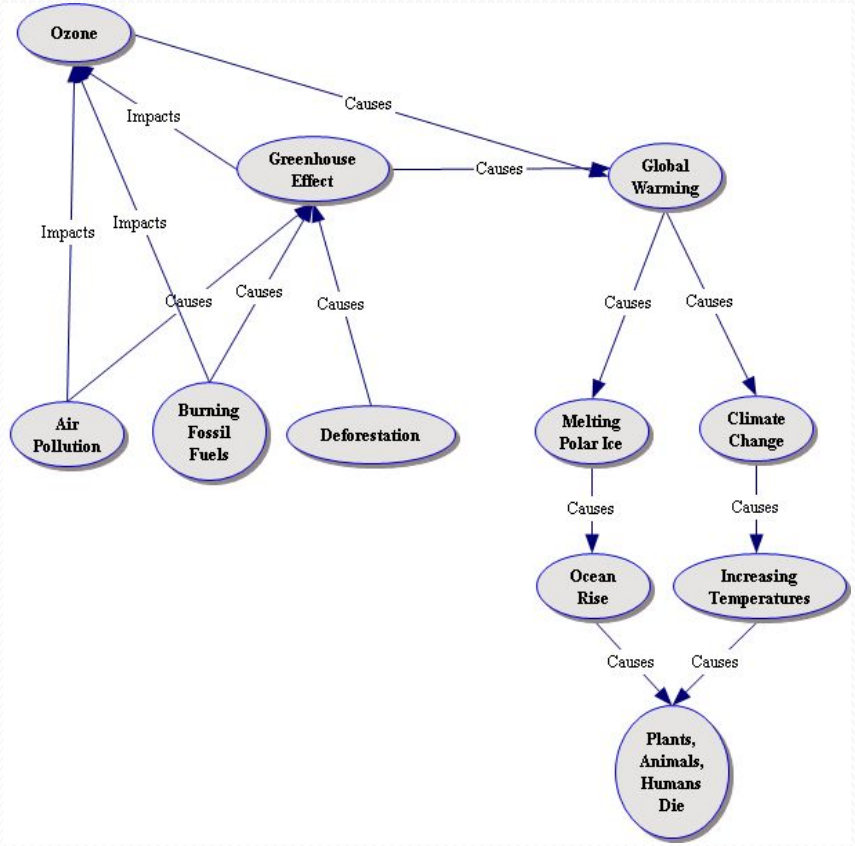
# Solution: Abstract ⟷ Concrete



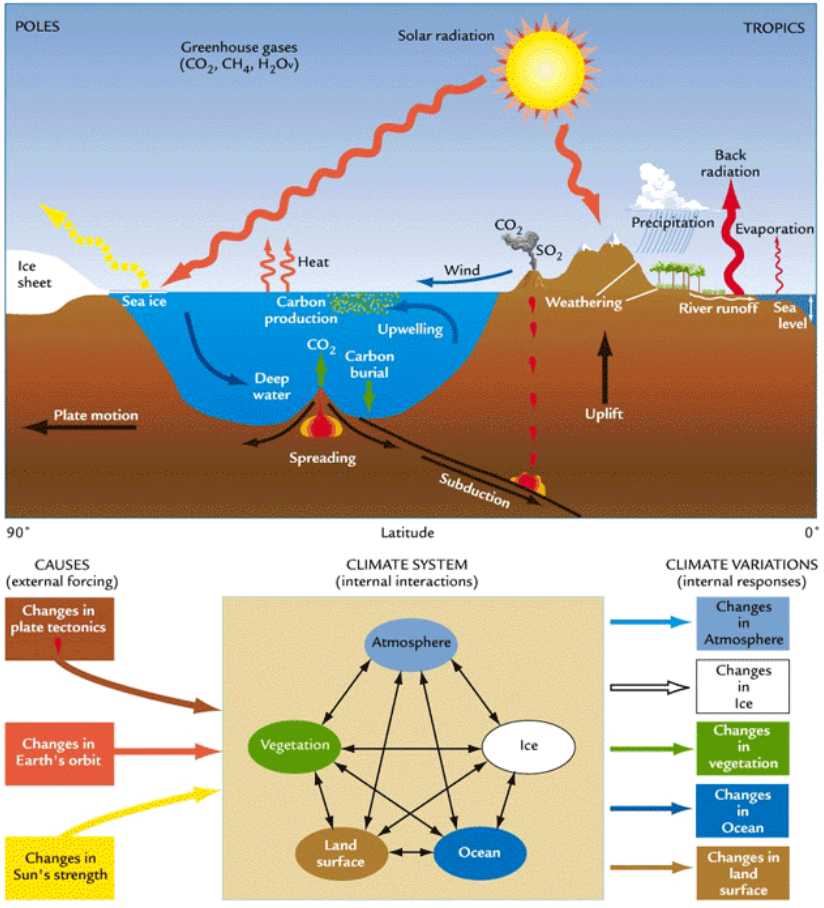


# Challenge: Student Conceptions



# Solution: Climate System

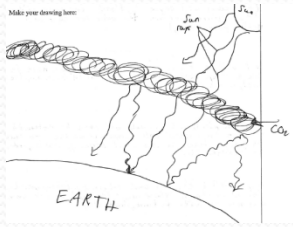


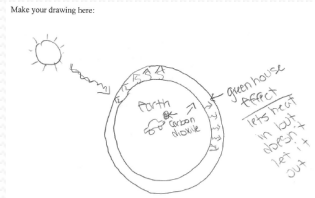
# *Teachers' (Adults') Conceptions of a Climate System*



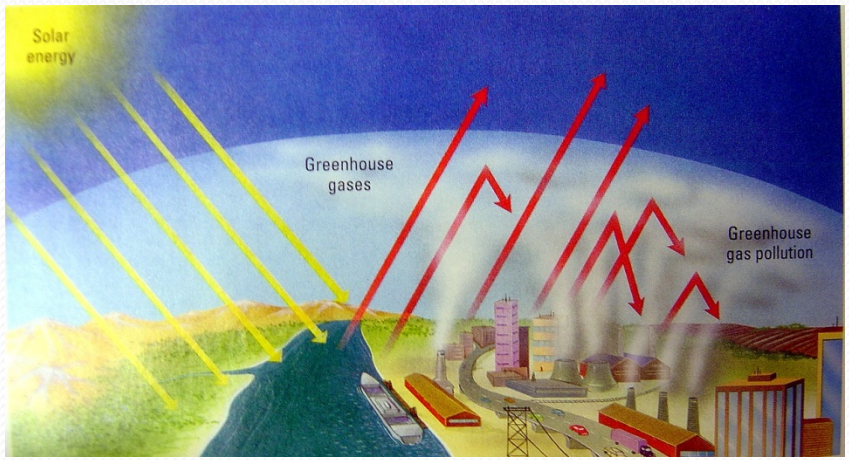
# Challenge: Student Conceptions

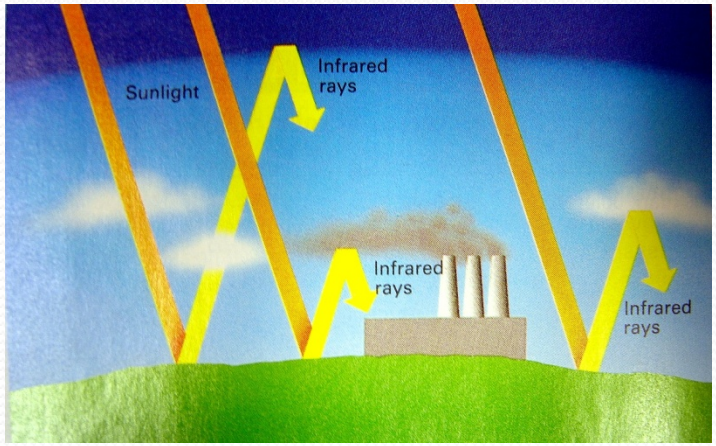
| Mental Model of the Greenhouse Effect | Totals (n=225) |
|---|---|
| Model 5. Sun's rays are "bounced" or reflected back and forth between the Earth's surface and greenhouse gases, heating the Earth (may or may not identify specific greenhouse gases) | 30 (13%) |
| Model 4. Greenhouse gases "trap" the sun's rays, heating the Earth (may or may not identify specific greenhouse gases) | 78 (35%) |
| Model 3. Greenhouse gases, but no heating mechanism, simply gases in the atmosphere | 38 (17%) |
| Model 2. Greenhouse gases cause ozone depletion or formation causing the Earth to warm | 14 (6%) |
| Model 1. "Greenhouse" for growing plants | 65 (29%) |



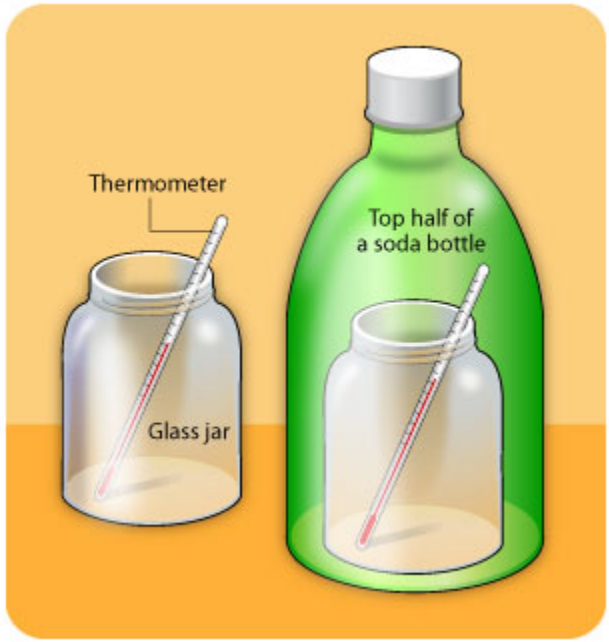



# Challenge: Textbook Diagrams



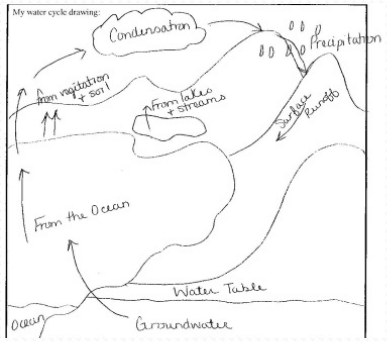



# Solution: Physical Model?



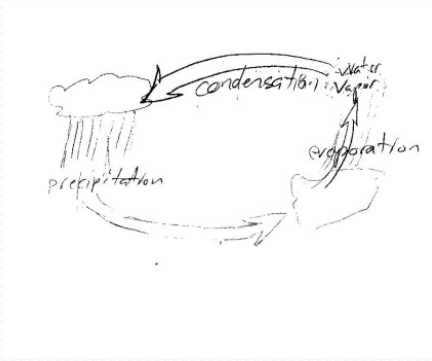
# Challenge: Student Conceptions

Conception 1: The Hydrologic Cycle as Water Storage, Transformation, and Transportation with multiple Pathways (27%)



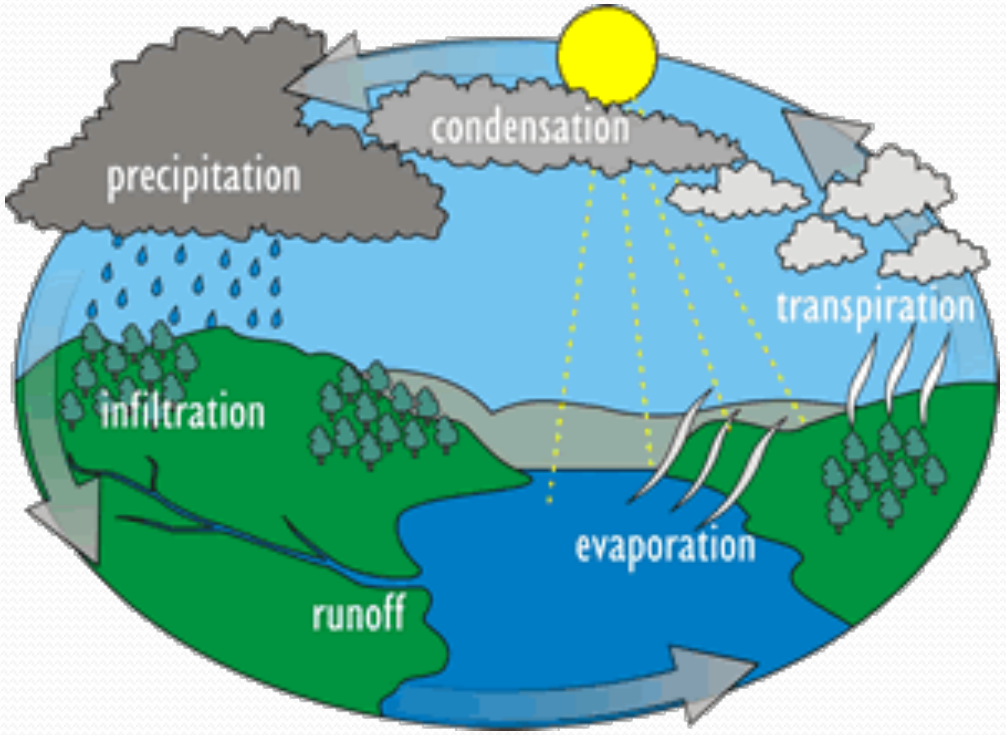

Conception 2: The Hydrologic Cycle as Water Storage and Transformation (36%)

Conception 3: The Hydrologic Cycle as a Weather Event (27%)




Conception 4: The Hydrologic Cycle as an Entity (10%)

# Challenge: Textbook Diagram

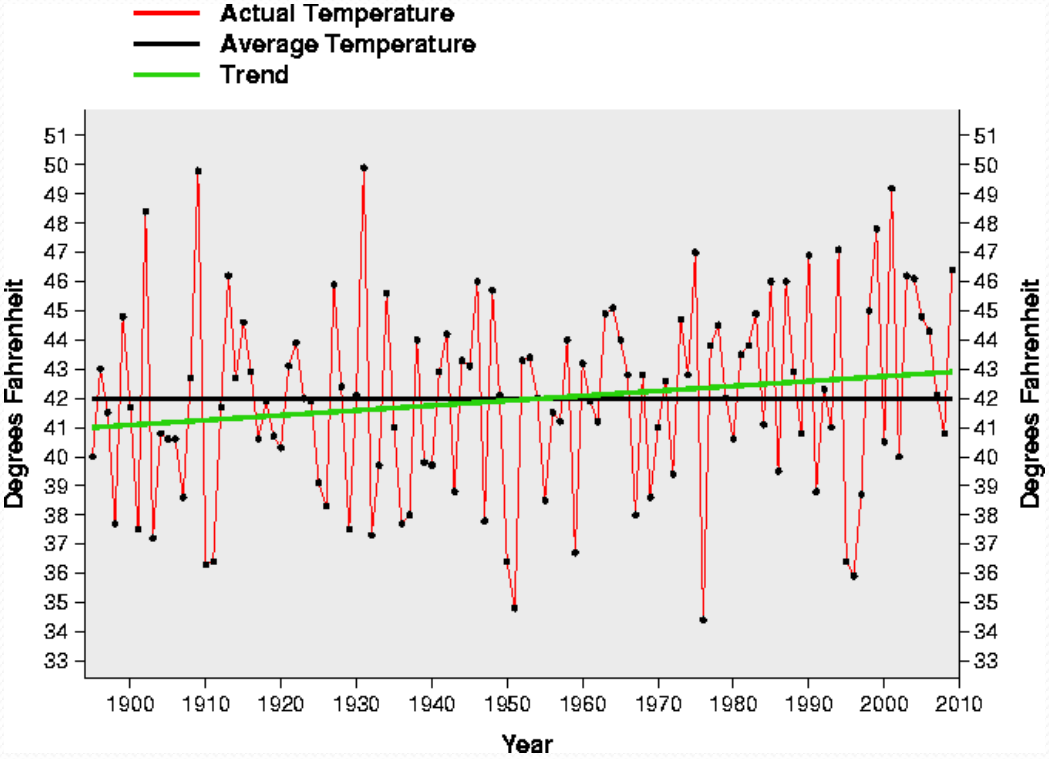


# Challenge: Experiencing Climate and Analyzing Data

- Ability to observe climate change
  - Collect local weather data, but cannot monitor climate change due to time and scale issues
  - We experience weather and often link it to climate change

- Data handling difficulties
  - Distinguishing between description and interpretation
  - Calculating and comparing means
  - Making and Interpreting graphs

# Solution: Weather and Data Indiana November Temperature

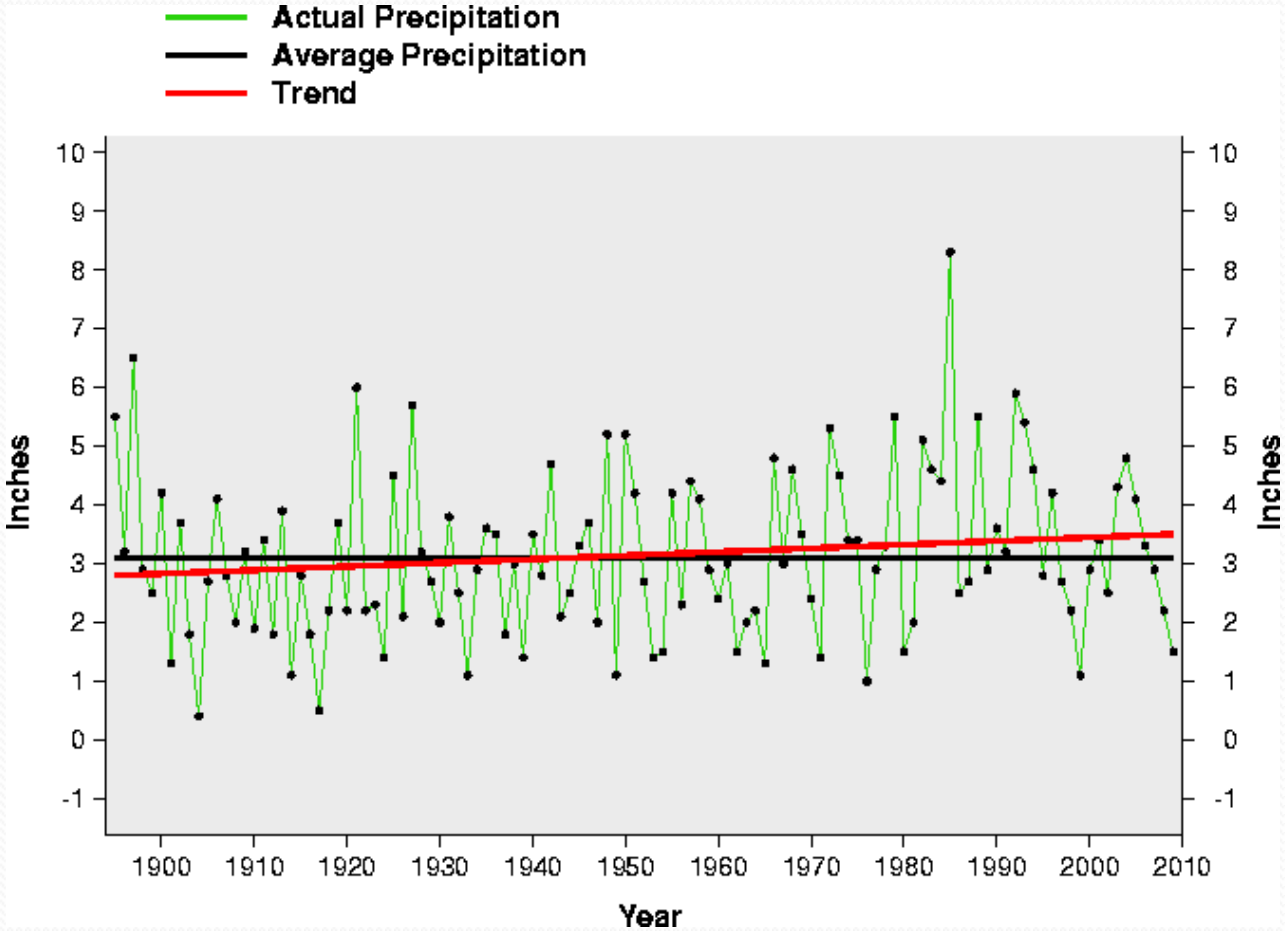



http://www.ncdc.noaa.gov/oa/climate/research/cag3/in.html

National Climatic Data Center http://www.ncdc.noaa.gov/oa/ncdc.html

http://www7.ncdc.noaa.gov/CDO/CDODivisionalSelect.jsp

# Solution: Weather and Data Indiana November Precipitation



# Implications: Drought Education

- Build a Community/ Network
- Develop Strategic/ Action Plan
- What are the Educational Needs
- Review Drought Curriculum
- Identify Misconceptions